GLAST Anticoincidence Detector (ACD) Top-Level System Requirements

1. Introduction

This document describes the top-level requirements for the GLAST ACD, independent of implementation.

2. Detection Requirements (in priority order, in case of conflict)

- The ACD shall detect minimum ionizing particles (MIP, signal denoted VETO, with threshold adjustable from 0.1 to 0.6 MIP in step size of 0.05 MIP) with an efficiency of at least 0.9997 over its entire area, in order to meet the instrument particle rejection requirement of 10^{-5} documented in the GLAST Science Requirements Document (SRD) and the GLAST report "Anti-Coincidence Detector Requirements and Implications for the GLAST Trigger and Rates."

- The ACD shall cover the top and sides of the GLAST tracker, in order to meet the field of view requirements of the SRD.

- The sensitivity of the ACD as a system to secondary particles and photons originating from very high energy gamma-ray showers in the calorimeter ("backsplash") shall be minimized; no more than 20% (TBR) of good gamma-ray events over the entire GLAST energy range shall be rejected due to backsplash, in order to meet the energy range up to 300 GeV called for by the SRD.

- The ACD shall produce a false VETO signal due to all noise with a rate lower than 1% of the rate of real incident background radiation at a nominal threshold of 0.3 MIP, in order to meet the effective area requirement of the SRD, i.e. for a typical tile rate of 1 KHz, the noise rate shall be < 10 Hz.

- The ACD shall provide a signal to the calorimeter when a highly-ionizing particle hits the ACD (energy deposit greater than 25 times a MIP, with threshold adjustable from 20 to 30 MIP in steps of 1 MIP, carbon-nitrogen-oxygen or heavier, denoted CNO), as described in the GLAST proposal.

3. Signal Requirements

- A MIP hitting the ACD shall produce a fast VETO signal that will be delivered to the hardware trigger logic within 250 nsec (latency - TBR) of the time of particle passage, for at least 0.9997 of incident particles.

- A MIP hitting the ACD shall produce a logic VETO signal that will be delivered to the data acquisition system (DAQ) software trigger within XXX nsec (TBD) of the time of particle passage. This may be a map of ACD VETO signals.

- The VETO output signal shall be longer than the time for baseline recovery following a signal to prevent "change of threshold" for following vetoes.

- Following an event that saturates the ACD electronics (e.g. an iron nucleus hitting the scintillator), the ACD shall recover sensitivity to a MIP within 10 μs (TBR), 1% of the average time between particles hitting the scintillator.

- A highly-ionizing particle hitting the ACD shall produce a fast CNO signal that will be delivered to the hardware trigger logic within XXX nsec (TBD) of the time of particle passage.

3. Monitoring Requirements

- The ACD electronics shall collect and transmit sufficient information to determine the pulse height over a range of 0.1 to 1000 MIP, with a threshold adjustable from 0.05 to 0.15 MIP; the precision at 1 MIP shall be < 0.05 MIP, and the precision above 20 MIP shall be < 1 MIP.

- The ACD electronics shall collect and transmit sufficient rate, temperature, voltage, and current information to monitor the performance of the ACD system and maintain its calibration to 5% (TBR).

4. Redundancy Requirements

- The ACD shall be constructed with sufficient redundancy that no single failure in the ACD electronics will cause the complete loss of signal from a detector element (tile).

- The ACD shall be constructed such that the loss of any one detector element (tile) will not cause a loss of more than 5% (TBR) of the instrument science data.

5. Commanding Requirements

- The ACD shall implement commands to power on and off each detector or group of detectors separately.

- The ACD shall implement commands to adjust the gain of each detector or group of detectors separately.

- The ACD shall implement commands to power on and off each redundant electronics system separately.

- The ACD shall implement commands to set the VETO threshold for each sensor.

- The ACD shall implement commands to set the CNO threshold for each sensor.

- The ACD shall have commands to adjust the monitoring function of the ACD electronics as needed to achieve adequate monitoring.

6. Power Requirements

- The ACD shall receive +28 V power through the DAQ.
- The ACD shall receive + 5 V power through the DAQ.
- The ACD shall receive + 3 V or + 3.3 V power through the DAQ.
- The ACD shall convert the received power to any other needed power internally.
- The ACD total power shall not exceed 55 W (TBR).

7. Mechanical Requirements

- The outer surface of the ACD shall be at least 40 mm (TBR) inside the launcher shroud envelope.
- The total mass of the ACD shall not exceed 252 kg (TBR).
- The ACD shall be capable of withstanding all conditions associated with a Delta 2 launch.